Weekly Report

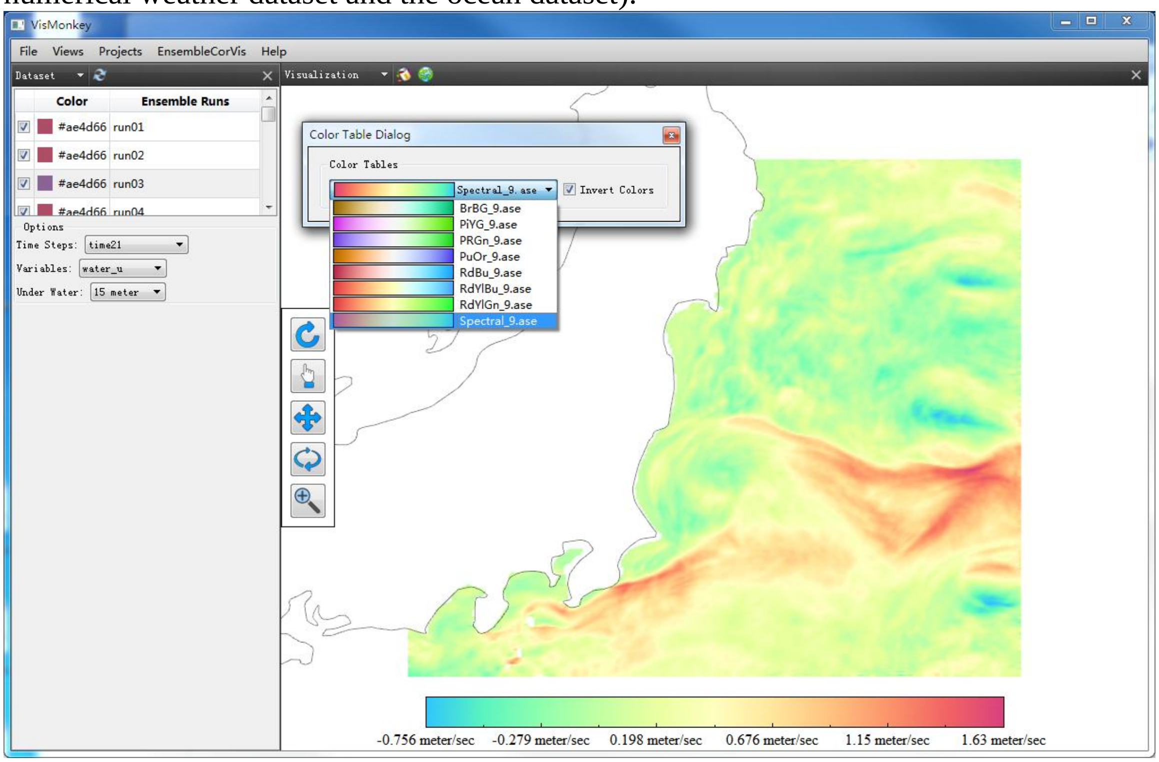
Period: 09/09/2013 – 09/15/2013

Projects

This week, we discussed the implementation details on parallel rendering for the Earth. We went through the code in our old system. In the next weeks, Biao and Haonan will implement this part on the parallel system and the browser based system.

Research

This week, I implemented a simple tool to read and visualize ensemble dataset (i.e. the numerical weather dataset and the ocean dataset).



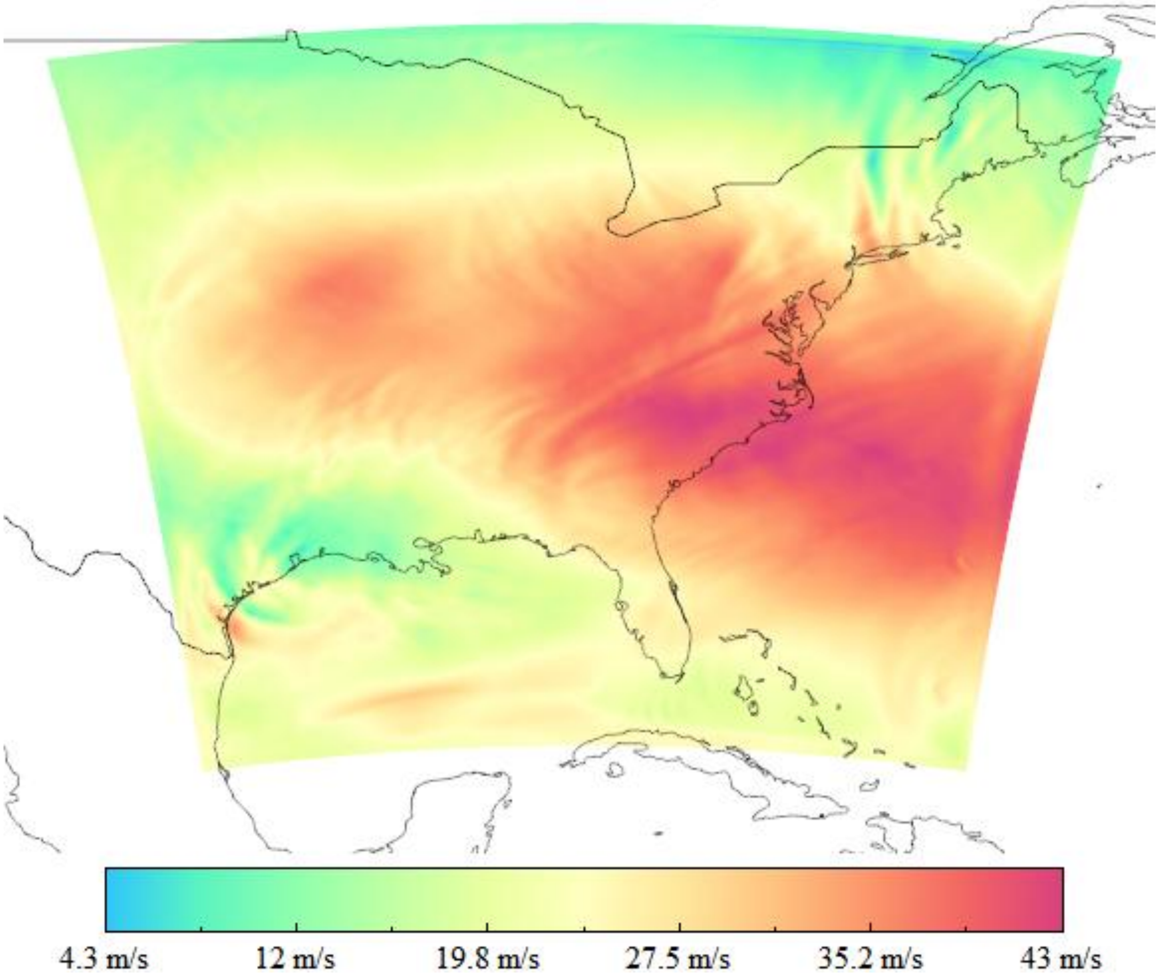
This tool is implemented to verify the data read/write programs. We can easily select an ensemble run at different times to see the resulting visualization of a variable. We can also choose different color mapping to encode the data. In the next week, I plan to incorporate the volume rendering method in this tool to review a 3D dataset.

Following, the basic concept to visualize correlation structures in ensemble dataset will be presented.

The motivation

For most enemble simulations, an ensemble of time series will be produce at each spatial location. Typically, these time-varying ensemble data items are spatially

correlated. In other words, all ensemble data items in a local spatial region exhibits same trends, for example the red area in the follwing picture may be regared as a structre. In this project, we would like to find this type of structure in the dataset.



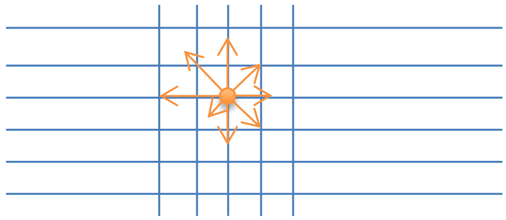
For deterministic dataset, this work has been fully studied. A simple solution is to build a graph where nodes represent the grid points and edge represents the correlation of two neighboring grid points. Then, algorithms like Graph Cut can be employed to segment this graph into several sub-graphs. Each sub-graph indicates a cluster of points that are highly correlated. However, these methods are not suitable for ensemble dataset.

Our method consists of following components:

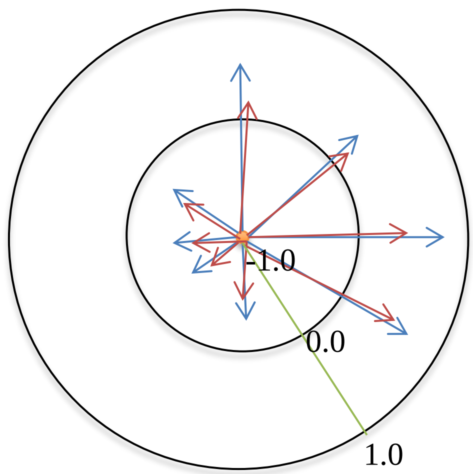
Correlation structure descriptor:

For certain dataset, the 2D tensor can be used to describe the local correlation structure at a point (See the following inset). In this figure, the length of the arrow indicates the magnitude of correlation in that direction. For simplicity, we call this tensor as

correlation tensor. The correlation tensors in the entire spatial domain can be used to for tensor clustering to partition the entire domain into several sub-regions. All correlation tensors in the same sub-region have similar shapes.



We further extend this idea to ensemble dataset, (see the following inset). In this picture, the color presents different ensemble runs (two runs in this example). The length of the arrow represents the value of correlation in that direction. Different from that for deterministic dataset, we encode the sign of correlation with different length of arrow. Arrows located between the outer circle and the inner circle indicate positive correlation. Other arrows indicate negative correlation.



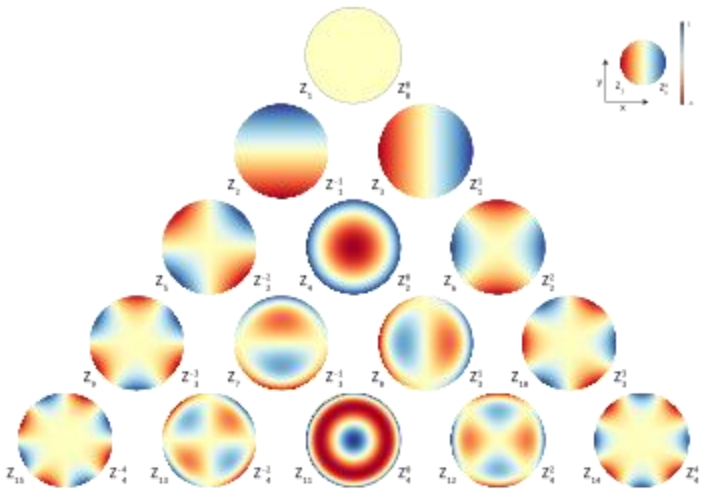
Methods like Zernike can be employed to fit a correlation structure function at each spatial location. The coefficients of the polynomial can further be used for clustering.

Correlation Clustering:

The polynomial coefficients of the correlation structure functions and the spatial coordinates defined a feature space. Many correlation clustering methods can be adopted in this feature space to partition the entire spatial domain into sub-regions.

Structure visualization:

For a specific spatial location, the correlation structure descriptor can be visualized as a glyph. Color encodes the types of correlation (positive or negative). The following images are just some mockups.
This method can also be easily extended to 3D space.



Work to be done in next week

- Revise the CAD&CG paper
- Record video for the TVCG paper
- Read papers on ensemble data visualization especially on correlation visualization

Reference: